Quality of Service Aware Routing in Wireless Multihop LANs
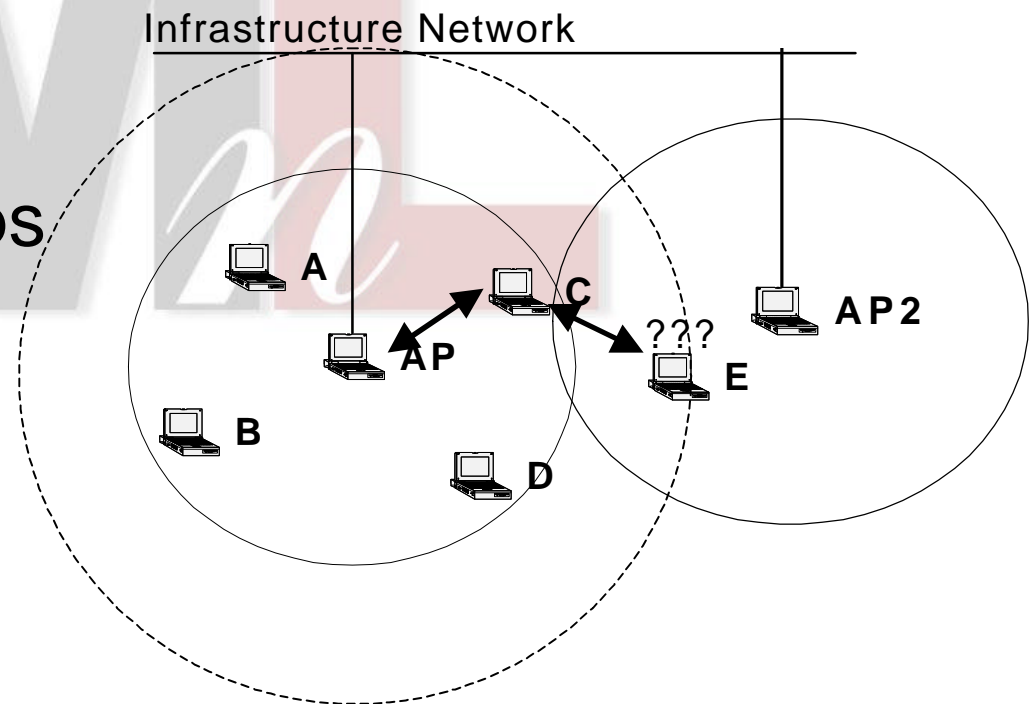
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Motivation: Extend WLAN coverage

- **Increase access range**
  - Power consumption
  - Low channel reuse
- **Additional APs**
  - Overlap between Aps
  - Cost efficiency
- **Multihop relay**
  - Flexibility
  - Extensive coverage

Infrastructure Network

A

C

??? E

A P 2

AP

B

D

Multihop WLAN architecture
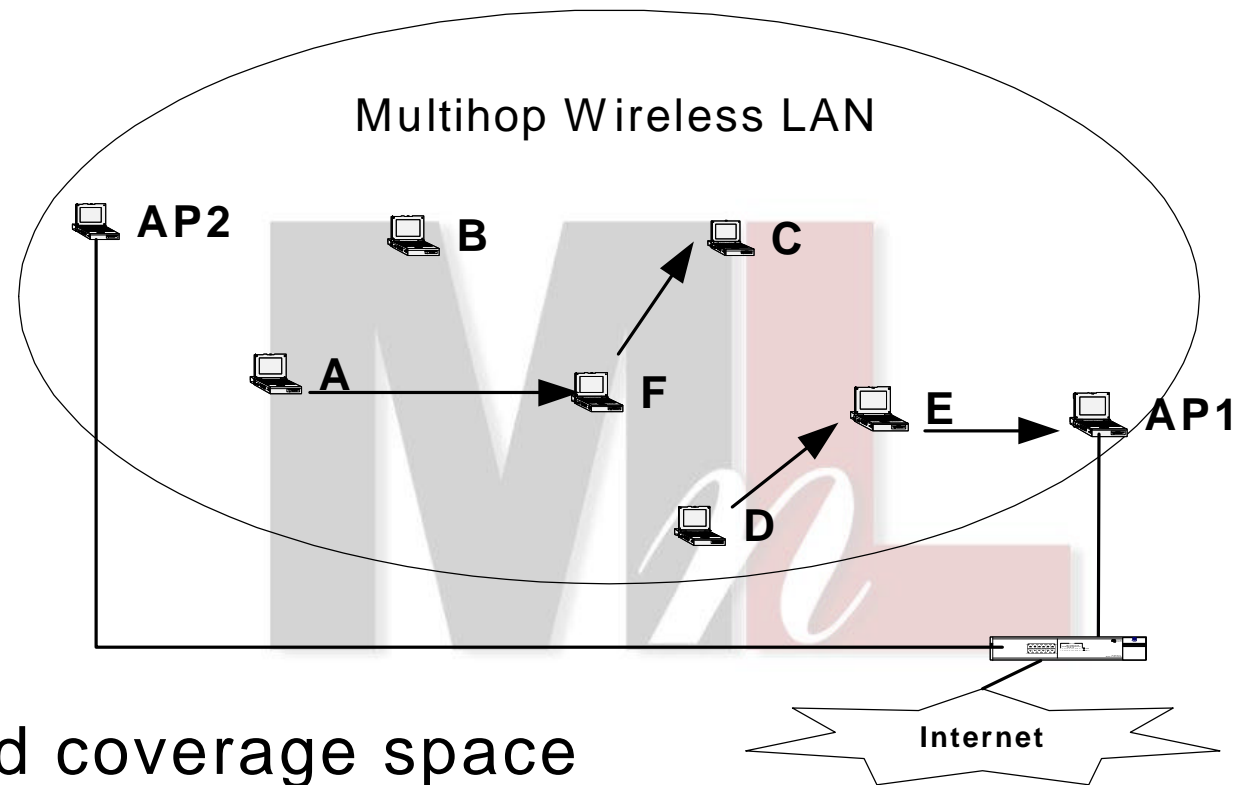
- Enlarged coverage space

- Better mobility support

- Distributed outgoing traffic load among multiple Aps

- Applications: Airport, hotel and conference hall, etc.

Routing in Multihop WLAN

- Internal traffic:
  - Route: within the multihop WLAN
  - Task: routing in <u>M</u>obile <u>Ad</u> hoc <u>Net</u>work(MANET)
- Outgoing traffic:
  - Route
    - Source→AP: MANET
    - AP→Destination: Wired Internet
  - Task: finding the "best" available AP
    - Outside address recognizable by the AP
    - AP acts as virtual destination

Proposed Solution

- **Routing in MANET with QoS constrains**
  - Bmin: the minimum bandwidth required by the flow
  - Tmax: the maximum end-to-end delay

- **Ad hoc Qos On-demand Routing (AQOR)**
  - Phase 1 - Traffic estimation
  - Phase 2 - Route Discovery
  - Phase 3 - Delay Constraint Guarantee
  - Phase 4 - Adaptive Routing

Phase 1- Traffic estimation

– Bavail(i) - the available bandwidth at node i, that can be used for new flows passing through node i.

– Breq(i, j) - the required bandwidth of flow j at node i, i.e., the bandwidth consumed by a new flow j if admitted on a route that includes node i.

Phase 2- Route Discovery

- Route exploration
  - broadcast route requests
  - bandwidth control
- Route registration
  - multiple replies along the reverse route
  - bandwidth and delay control
- Route activation
  - Activate on the first data packet
  - Temporary bandwidth reservation

Phase 3 - Delay Constraint

- Estimate end-to-end delay by measuring round trip delays (difficult problem in unsynchronized ad hoc networks)

Transmission delay

Phase 4 - Adaptive Routing

- **QoS Violations**

  - <u>Channel deterioration</u> in one of the links of the active route.

  - <u>Route break:</u> node on the active route leaves the route
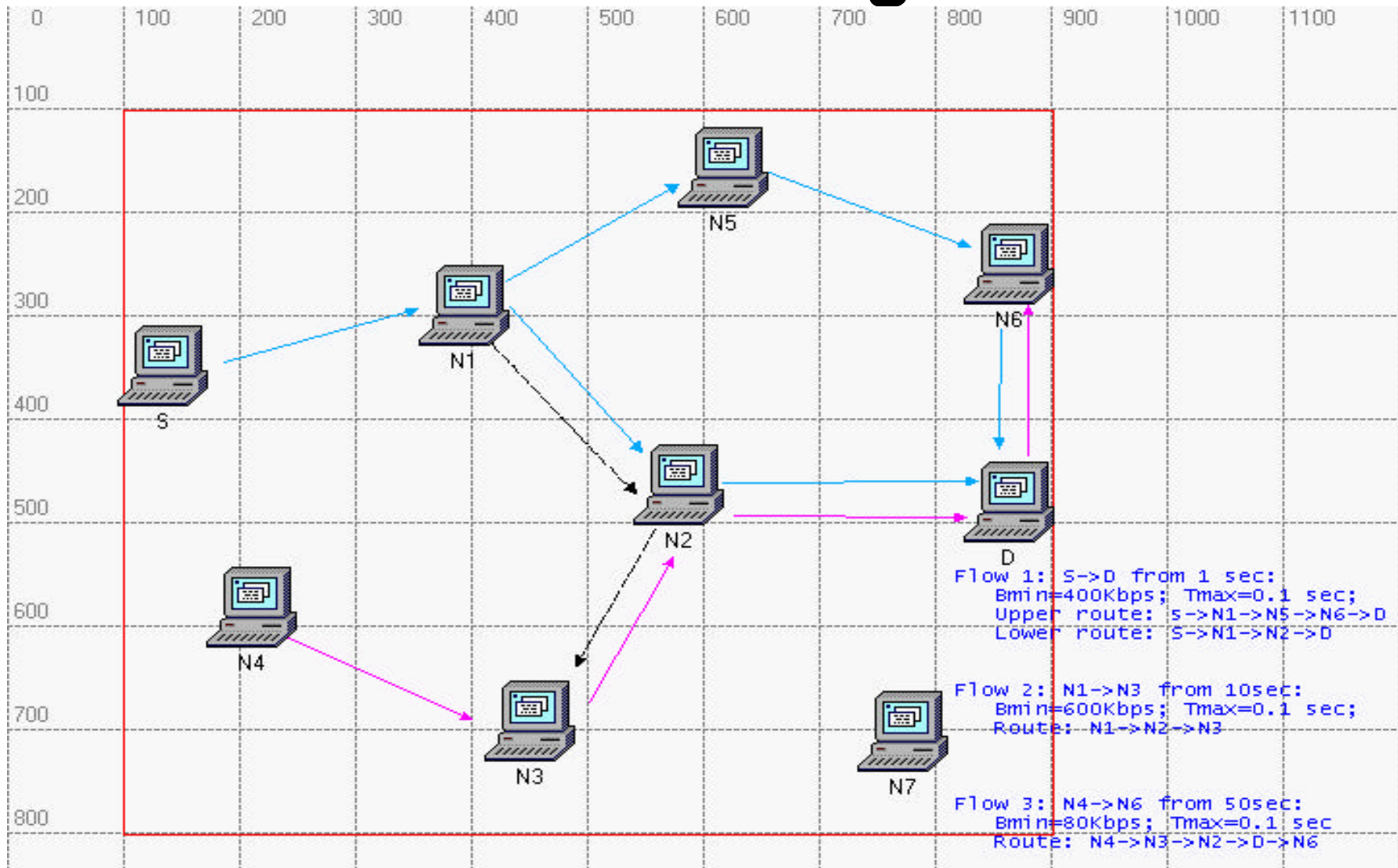
- **Route Recovery**

  - QoS violation detection

  - Reverse exploration

  - Route switching

Basic Comparison with Existing MANET Routing Protocols

	AQOR	**AODV**	**DSR**
On demand	Yes	Yes	Yes
Neighborhood	Yes	Yes	No
QoS support	Yes	No	No
Recovery	Registered nodes	Entire network	Entire network
Routing path	Adaptive	Fixed	Fixed

Simulation using OPNET

Flow 1: S->D from 1 sec:
Bmin=400Kbps; Tmax=0.1 sec;
Upper route: S->N1->N5->N6->D
Lower route: S->N1->N2->D

Flow 2: N1->N3 from 10sec:
Bmin=600Kbps; Tmax=0.1 sec;
Route: N1->N2->N3

Flow 3: N4->N6 from 50sec:
Bmin=80Kbps; Tmax=0.1 sec
Route: N4->N3->N2->D->N6

Accessible range: 300 meters, Data rate: 11Mbps

Conclusion

- Provision of extended coverage at low cost

- Accommodate more customers due to load balancing achieved by AQOR

- Seamless integration of an ad hoc wireless LAN within a wired infrastructure

- Robust communication is achieved by integrating QoS in the routing protocol

- Accommodate Service Layer Agreements (SLA) in wireless LANs

- QoS can be provided if 802.11e NIC card is used